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THE VARIATIONS OF GLACIERS. XIV[1]

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The following is a summary of the *Thirteenth Annual Report* of the International Committee on Glaciers.[2]

REPORT ON GLACIERS FOR 1907

The greater number of the glaciers of which we have any information are retreating; the glaciers of the Scandinavian Alps alone are entering a period of advance; this advance, which started some years ago in the Jostedal, became fairly general in 1907.

Swiss Alps.—The retreat is general, but nevertheless it is not so strong as during the preceding years, which is probably due to changes in meteorological conditions. Of the fifty glaciers observed only one, the Glacier de Vorab, in the basin of the Rhine, has shown any marked growth. It advanced 133 meters between 1904 and 1907.[3]

Eastern Alps.—Of the twenty-five glaciers observed in 1906–7, twenty-four are retreating and one is stationary; therefore the slight advance indicated by some glaciers in 1905 has given way to a general retreat.[4]

Italian Alps.—Observations on glaciers on the south side of Mont Blanc, and in the Lombard and the Venetian Alps, show a retreat more or less marked.[5]

French Alps.—Measurements of the amount of snowfall in the neighborhood of Chamonix show that in the winter of 1906–7 the quantity of snow which fell was 20 to 25 per cent. greater than for many years past. This region seems to be passing through a snowy period; nevertheless the glaciers themselves are still retreating, and we shall probably have to wait many years before the heavy snowfall becomes effective in an advance of the ice. In the Maurienne also the retreat is general. In the Dauphiné observations have shown very heavy snowfalls and continued retreat of the glaciers.[1]

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[1] The earlier reports appeared in the *Journal of Geology*, Vols. III–XVL.

[2] *Zeitschrift für Gletscherkunde*, 1909, Vol. III, pp. 161–85.

[3] Report of Professor F. A. Forel and M. E. Muret.

[4] Report of Professor E. Brückner.

[5] Report of Professor O. Marinelli.

Pyrenees.—In the Pyrenees the heavy snowfalls covered the small glaciers so completely that satisfactory observations could not be made.[2]

Norway.—A marked change has occurred in the glaciers of Jotunheim; in 1904–5 only six of these were advancing and seventeen were retreating. In 1905–6 seven were advancing and the same number retreating. In 1906–7 fifteen were advancing and only three retreating. In the region of Jostedal and Folgefon the advance, which began earlier, continues to hold its own.[3]

Russia.—Two glaciers in the Caucasus seem to be in retreat; but the Midagrawin and Devdorak, in the Kasbek group, are apparently advancing. The latter glacier is extremely interesting as it has been the cause of many disasters in the Dariel pass. In southern Asia all the glaciers observed are retreating but in the western Pamir the snowfall seems to have increased markedly.[4]

Canada.—The observations of the Messrs. Vaux show that a number of glaciers, namely, the Illecillewaet, the Asulkan, the Victoria, and the Yoho, have all retreated in 1906–7, and some of them very strongly. The Asulkan and the Victoria had been approximately stationary for several years.[5]

Himalaya.—The Geological Survey of India has undertaken to survey the ends of the great Himalayan glaciers for the purpose of determining their variations, so that we may expect definite results before very long.[6]

REPORT ON THE GLACIERS OF THE UNITED STATES FOR 1908[7]

The Big Timber Glacier in the Crazy Mountains of Montana was visited in 1907 by Messrs. Wolff and Mansfield. The general

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Report of M. Ch. Rabot.

[2] *Ibid.*

[3] Report of M. P. A. Oyen.

[4] Report of Colonel J. de Schokalsky.

[5] Report of MM. George and William S. Vaux.

[6] Report of Mr. Douglas W. Freshfield.

[7] A synopsis of this report will appear in the *Fourteenth Annual Report* of the International Committee. The report on the glaciers of the United States for the year 1907 was given in this *Journal*, Vol. XVI, pp. 666–68.

appearance of the glacier indicates that it has been stationary during recent years.[1]

The Arapahoe Glacier, Colorado, does not seem to have changed since 1907, though the winter of 1907–8 was very dry (*Henderson*). The Hallett Glacier has receded slightly (*Mills*).

Professor W. D. Lyman reports that there are large glaciers along the Olympic Mountains in Washington. In particular, the Ho Glacier, on Mt. Olympus, is almost comparable with the glaciers of Mt. Rainier.

Mr. Fremont Morse, of the United States Coast and Geodetic Survey, has kindly sent the following account of the Alsek Glacier, and others near it, at the southeast end of the Brabazon range and northwest of the Fairweather group:

> The Alsek Glacier is divided at the discharging face by a nunatak, and the lower portion discharges into a deep lake in which the largest bergs float around freely. The face showed no perceptible change in location between 1906 and 1908, but this portion of the glacier was considerably more active than it was in 1906, according to the report of my assistant, Mr. L. Netland, who was up the river both seasons. The upper portion of the glacier, above the nunatak, is apparently dying. The ice in it is all dirty, and but few bergs were detached from the face while we were in the vicinity. The face has retreated since 1906, and at the low stage of the river in September there was a gravel bar exposed in front of the ice face.
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> The next great glacier up the river is on the right bank in the next bend of the river. It is directly connected with the great ice-reservoir from which the nunatak and Hidden glaciers discharge into Russel Fiord, and from which the Yakutat Glacier flows toward the ocean. This glacier seems to be retreating. Its front is now about two and a half miles from the river bank.
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> At the second canyon of the Alsek the glacier which forms the left bank of the canyon seemed to be advancing slightly on its east side. There the ice was crushing the alder bushes on the lateral moraine in one place that came under my notice. I cannot say whether the front of the glacier had advanced since 1906, but Mr. R. D. Ritchie, assistant to the Canadian representative who was with my party, and who was up the river in 1906, said the glacier was much more active than at the time of his former visit.
>
> I judged from the appearance of the numerous small glaciers in the canyons that the general movement of the ice in the region adjacent to the Alsek was one of retreat.

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[1] George Rogers Mansfield, "Glaciation in the Crazy Mountains of Montana," *Bull. Geol. Soc. Am.*, Vol. XIX, pp. 558–67.

The Grand Pacific Glacier, which debouches into the upper end of Glacier Bay on the south and into the valley of the Alsek River on the north, seems to be retreating in its northern portion (*Netland*). This is in conformity with the marked retreat of its southern end, reported for several years.

Dr. L. S. Camicia has been keeping a record since 1901 of the position of the Valdez Glacier, Prince William Sound, Alaska. A stone monument was made on the moraine in front of the glacier and the distance to the ice determined. He found the following variations, measurements having been made in June of each year: 1901–2, a retreat of 39 feet; 1902–4, 165 feet; 1904–5, 138 feet. The next observation was made in October, 1908; as the monument had been destroyed, he estimated its position as well as he could, and found a retreat since the last observation of 244 feet, making a total retreat from 1901–8 of 586 feet. The destruction of the monument seems entirely explained by the advance recorded in the following account kindly sent me by Professor U. S. Grant:

NOTES ON THE GLACIERS OF PRINCE WILLIAM SOUND, ALASKA, 1908

Maps showing the location of these glaciers may be found in Vol. III of the *Harriman Alaska Expedition*, and in *Bulletins 284* (p. 79) and *345* (p. 177) of the U. S. Geological Survey.

Valdez Glacier.—The western part of the front of this glacier was visited about August 1, 1905, and again on July 11, 1908. Some time during this interval the glacier has advanced 250 to 350 feet and built a moraine and then retreated nearly to its former position. On the extreme western edge the ice in 1908 was about 100 feet in advance of its position in 1905.

Shoup Glacier.—This glacier was visited on July 4, 1905, and on July 13, 1908. The front was practically in the same position on each of these dates.

Columbia Glacier.—This glacier was visited by the Harriman Expedition on July 25–27, 1899, and by Grant on July 10, 1905, and July 15, 1908. At the north end of Heather Island photographs show the precise position of the front of the glacier at these three dates. In 1905 the ice front had retreated 160 feet from its position in 1899, and in 1908 it had advanced 112 feet beyond its position in 1905.

Glaciers of Icy Bay.—The maps of this bay, which lies west of the south end of Chenega Island, show it to be about four and a half miles long, with a glacier at its head. A traverse of the shoreline of this bay in 1908 shows it to be about 11 miles in length with a tide-water glacier at its head. On the north side of the bay, 6 miles from its head, is a smaller bay, nearly two miles in length; and at the head of this smaller bay are two tide-water glaciers. The description of Whidbey, who was attached to Vancouver's exploratory expedition of 1794, states that this bay was four and a half miles deep and was terminated by a perpendicular cliff of ice. This would seem to indicate a retreat of ice in the axis of Icy Bay of some six and a half miles from 1794 to 1908.

Glaciers of Port Nell Juan.—There are three tide-water glaciers in this bay, all showing retreat in recent years. The largest of these glaciers is in the third (from the entrance) of the southerly arms of Port Nell Juan. Near the western side of the end of this glacier there is a granite knob, rising some 175 feet above tide, on which is a small moraine marking an advance of the ice into a straggling forest. This advance was probably about 20 years ago, since which there has been a retreat of the ice for 500 feet.[1]

Barry Glacier.—In 1905 this glacier was found to have retreated markedly since 1899. It was visited again in 1908 and its front was found to have retreated on the east side about a fourth of a mile, and more than this on the west side, since 1905.

Bainbridge Glacier.—Within the last few years this glacier has retreated to a small extent as shown by a bare, treeless zone on the south side of the front, and by a small moraine on the north side of the front. This moraine on August 3, 1908, was 30 to 60 feet in front of the end of the glacier, and the moraine in part lies against a forest some of whose trees were overturned by the ice.

The Matamaka Glacier, the source of the river of the same name, which flows into the head of Cook Inlet, was apparently retreating in 1905. The glacier was from three to five miles at its end (*Griffith*).

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[1] There was a slight advance of Muir Glacier between 1890 and 1892.